

3D Printed Face Shield

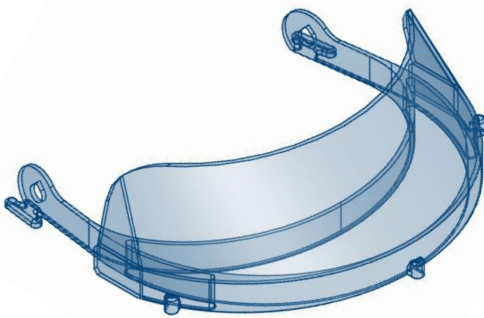
Applicability

Personal Protective Equipment (PPE) is in high-demand during the COVID-19 pandemic and Makers are mobilizing to produce designs and functional prototypes to get protective equipment quickly into the hands of those who need it urgently.

According to the CDC, COVID-19 is believed to be spread mainly from person-to-person contact through respiratory droplets produced when the infected person coughs or sneezes¹. Face shields provide a physical barrier for the user against airborne droplets.

Several open source face shield designs are available that can be produced rapidly by using inexpensive and distributed Fused Deposition Modeling (FDM) plastic 3D printing for the visor together with polyethylene sheeting for the face protection.

In addition to health care professionals (HCPs), others that can benefit from access to face shields as a first line of defense include first responders, security personnel, and those working in essential customer service (grocery stores, pharmacies, and delivery services). The availability of 3D printed face shield designs for the general public can also ease the demand on traditional supply chains used by HCPs.



Iterated visor design

Design

An open source design for a 3D-printed face shield visor was iterated upon in order to improve producibility and speed to print. The visor is designed to accept a polyethylene/polycarbonate sheet with holes produced using a 3-hole punch. A brow cover was also designed to prevent droplets from falling onto the user's face. On the Prusa i3 MK3, this design prints without supports. The build time is approximately 2.5 hours for a single visor and up to 2 visors can be printed in a single build, which takes 5 hours.

Limitations

A face shield does not substitute the use of an approved face mask.

In cases where approved masks are not available and a non-approved mask is used as a last resort, CDC guidance recommends use of a face shield in conjunction with the non-approved mask².

[1] <https://www.cdc.gov/coronavirus/2019-ncov/prepare/transmission.html>

[2] <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/face-masks.html>

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Print Time: 2hr 30min (Prusa i3 MK3)

Best Practices from Open Source Designs

- Use three-hole punch size and spacing for ease of assembly and replacement of polyethylene sheet
- Include a brow guard to provide continuous coverage over the user's forehead
- Designs using a single 3D printed piece print faster and reduce assembly steps as compared to those designs having a separate support piece at the bottom of the clear shield
- Two methods of attaching elastic or string:
 - Hooking over tab
 - Looping through hole

Fabrication and Assembly

- FDM 3D Print:
 - 0.3mm layer height
 - 30% infill
 - No supports
 - 50 mm/s (perimeters)
 - 85 mm/s (infill)
 - 180 mm/s (non-print travel travel)
- Plastic Sheet (0.15" thickness)
 - Cut to 9" x 9"
 - Use three-hole punch on top edge
 - Align the holes to the hooks and snap into place
- Elastic band
 - Cut to 11" length
 - Make a 3/4" cut on either side to hook over tab
- String
 - Cut to 11" length
 - Loop through holes on either side and tie to secure

Sanitization

- FDM 3D prints are porous so some methods of sanitization may not be as effective
- CDC Guidelines: <https://www.cdc.gov/coronavirus/2019-ncov/community/organizations/cleaning-disinfection.html>
- Prusa Work-In-Progress Guidelines: https://help.prusa3d.com/en/article/prusa-face-shield-disinfection_125457